NACA INLETS

The National Advisory Committee for Aeronautics did some research on submerged duct entrances in January of 1948. We see many of these "NACA inlets" on homebuilt aircraft. Some of the features that are "optimized" for best efficiency are features that we don't see on all NACA inlets. Although straight side walls can be used on these inlets, curved diverging ramp walls are best. Also the ramp angle works best at a 5 to 7 degree angle (a feature which is rarely seen). Most NACA inlets on amateur built aircraft are considerably shorter and stubbier than the "optimum". The actual inlet opening below the lip works best when the ratio of width to height is from 3 to 5; 4 to 6 gives the highest pressure recovery. On our example we have a ratio of 4" width to 1" height. To reduce the length of the duct to be used, use as steep a ramp as is practical to reduce the length. The floor may be straight or slightly curved. The report shows a curved floor that is possible to use. Our example uses a straight floor. A smooth junction between the floor and fuselage should not noticeably affect pressure or coverage. The inclination of the inlet floor (optimized at 7 degrees) is the **major** geometric parameter influencing recovering.

Some of the nice features of the NACA duct are reduced external drag and cleaner aerodynamics. For low mass airflow rates, the NACA submerged inlet with diverging walls offers improved pressure recovery.

This duct works best in the area of the thinnest boundary layer, which for many aircraft is the most forward point either on the fuselage, wings or on wheel pants. It is an excellent feature for a wheel pant - it won't snag and can provide cooling flow to the brakes.

The steps to draw one are as follows:

1. Obtain the lip for the specific entrance. Multiply the ordinates in Table 1 by the entrance depth in inches. In our example this is 1". You can use a caliper to measure out the height and length carefully or shrink our example to fit your duct on a copy machine. The lip is **highly important** and should not be dispensed with. As the lip is so small, you may wish to draw it in a larger scale and then reduce it.

2. Determine the ramp angle. Seven degrees was used in our example. Add the depth of lip at the point of rotation (which is 75% back from the edge) to the depth of entrance. Divide this by the tangent of the ramp angle. In our example, this would be 1.481" divided by the tangent of 7 degrees or 1.481" divided by .12278 equals 12.062" in length. Subtract the .75" from the point of rotation to the lip which gives us an outward length of 11.312".

3. Multiply the Table 2 ramp X/L coordinates by your length to get those stations. In our example, I used 11.312" to get the 7 degree ramp.

4. Multiply the Table 2 Y/W coordinates by the width of inlet to get the curve of the side walls. Our entrance is 1" high by 4" wide. In this case I multiplied Y/W times 4 to get these dimensions (Y/W is from the centerline).

5. To get other ramps, shorter ones are possible. You can shrink the length by reducing the length of the duct X/L coordinates while leaving duct width Y/W the same or do your own design work by ordering the NACA Research Memo A7130 dated January 8, 1948 from the EAA Boeing Library. The cost is $11 plus postage. They will bill for total cost and send it first class.

Table 1

STA.	Yu	YL
0.0	.197	.197
.125	.087	.325
.250	.056	.375
.375	.056	.412
.500	.021	.440
.625	.012	.462
.750	.006	.481
.875	.002	*
1.000	.000	*
L.E. RADIUS = .094		

* DETERMINED BY THE INTERNAL DUCT

Table 2

CURVED	DIVERG.
X/L	Y/W
0	.500
.10	.497
.20	.457
.30	.362
.40	.307
.50	.233
.60	.195
.70	.157
.80	.118
.90	.080
1.00	.042